REMARKS

Entry of the foregoing amendments and favorable consideration of the subject application is respectfully requested in view of the following comments.

Claims 1-20 are currently pending in this application, claims 1 and 16 have been amended and claims 5, 11, 13 and 19 have been cancelled. Accordingly, claims 1-4, 6-10, 12, 14-18 and 20 are herewith presented for the examiner's consideration.

The amendments herein contain no new matter and are considered to define the present invention over the prior art and to place the application in consideration for allowance. Accordingly, Applicants respectfully submit that the amendments herein are in proper condition for entry.

Amendment Of Claims

Claims 1 and 16 have been amended in response to the examiner's rejections to limit component (A) "a polyfunctional polymerizable monomer selected from the group consisting of glycerol dimethacrylate and tetramethylolmethane triacrylate". This limitation is fully supported in the specification as filed at page 6, line 22 and page 7, lines 3-4. Also, Claim 16 has been amended to add in (B) "the group consisting of" in line 2, and to add "and" in line 5 of (B).

In conjunction with this limitation of the component (A) to one of the two listed monomers, claims 5, 11, 13 and 19 have been deemed improper and have been cancelled.

No further amendments to the claims have been made and Applicants respectfully submit that the amendments made herein are fully supported by the specification as filed and do not introduce any new matter.

Rejection of Claims 1-15 under 35 U.S.C. §103(a)

The Office Action rejects claims 1-15 under 35 U.S.C. § 103(a) as being unpatentable over Hashimoto, et al. (U.S. 6,037,388) in view of Rhienberger, et al. (U.S. 6,353,039), when taken with Ohno, et al. (U.S. 5,171,763). The Office Action states:

> "Regarding claims 1-2, 4-6, and 10-13: Hashimoto et al. teaches a dental adhesive composition (1:14-20) comprising polymerizable methacrylate monomers in 30-90 weight% (mono and/or polyfunctional, with polyfunctional monomers based on methacrylic acid esters of a polyhydric alcohols) (4:17-24; 4:36-60; 5:1-15); polymerizable monomers having a carboxylic acid group in 2-20% (9:28-47; 9:54-57); an organoboron compound in 1-30 weight% (2:23-49); and filler in an amount of 0-60 wt% [instant claim 2] (9:58-10:24; 10:35-38; 12:23-29; 13:32-40); wherein the total of components is 100% (4:17-24; 13:34-40).
>
> Hashimoto et al. does not teach polyfunctional monomers based on esters that contain 1-2 hydroxyl groups in an amount of 1-30 wt% [instant claim 1]. However, Rhienberger et al. teaches a dental composition comprising dilution monomers (based on methacrylic acid esters), which contain at least 2 polymerizable groups and 1-2 hydroxyl groups (5:29-51), specifically glycerol dimethacrylate (5:41-42), in an amount of at

least 5% (6:1-9) [instant claims 1, 4-6, and 10-13]. Hashimoto et al. and Rhienberger et al. are combinable because they are concerned with a similar technical difficulty, namely the preparation of dental materials. At the time of invention a person of ordinary skill in the art would have found it obvious to have combined dilution monomers, as taught by Rhienberger et al. in the invention of Hashimoto et al. and would have been motivated to do so since Rhienberger et al. suggests that dilution monomers provide composites with high filler contents (5:30-33), and is an equivalent alernative means of providing a polymerizable composition for dental applications.

Ohno et al. (US 5,171,763) provides evidence of dental materials (1:5-15) comprising acid containing monomers (2:20-39), ion-leachable fillers (2:39-41, 10:11-60), and polyfunctional polymerizable compounds having -OH groups {pentaerythritol trimethacrylate} (9:5-10).

Regarding claim 3: Hashimoto et al. teaches solvent in 10-150 parts by weight, based on 100 parts organoboron compound, specifically 0.1-45 weight% (2:16-21; 2:55-3:10; m4:17-25).

Regarding claims 7 and 14: Hashimoto et al. teaches the acid group containing polymerizable monomer is 4-methacryloyloxyethyltrimellitic acid and 4-methacryloyloxyethyltrimellitic anhydride [instant claim 7 and 14] (9:36-37).

Regarding claims 8 and 15: Hashimoto et al. teaches the organoboron compound is tributylborane and/or partially oxidized tributylborane [instant claims 8 and 15] (2:45-50; 11:38-12:5).

Regarding claim 9: Hashimoto et al. teaches the filler is polymethylmethacrylate particles (11:34-36).

Rejection of Claims 16-20 under 35 U.S.C. §103(a)

The Office Action rejects claims 16-20 under 35 U.S.C. § 103(a) as being unpatentable over Hashimoto, et al. (U.S. 6,037,388) in view of Rhienberger, et al. (U.S. 6,353,039), when

taken with Ohno, et al. (U.S. 5,171,763). The Office Action states:

> Regarding claims 16-17 and 19: Hashimoto et al. teaches a dental adhesive composition (1:14-20) comprising polymerizable methacrylate monomers in 30-90 weight% (mono and/or polyfunctional, with polyfunctional monomers based on methacrylic acid esters of a polyhydric alcohols), specifically methyl methacrylate (4:17-24; 4:36-60; 5:1-15); polymerizable monomers having a carboxylic acid group in 2-20% (9:28-47; 9:54-57); an organoboron compound in 1-30 weight% (2:23-49); and filler in an amount of 0-60 wt% [instant claim 17] (9:58-10:24; 10:35-38; 12:23-29; 13:32-40); wherein the total of components is 100% (4:17-24; 13:34-40).
>
> Hashimoto et al. does not teach polyfunctional monomers based on esters that contain 1-2 hydroxyl groups in an amount of 1-30 wt% [instant claim 16]. However, Rhienberger et al. teaches a dental composition comprising dilution monomers (based on methacrylic acid esters), which contain at least 2 polymerizable groups and 1-2 hydroxyl groups (5:29-51), specifically glycerol dimethacrylate (5:41-42), in an amount of at least 5% (6:1-9) [instant claims 16 and 19]. Hashimoto et al. and Rhienberger et al. are combinable because they are concerned with a similar technical difficulty, namely the preparation of dental materials. At the time of invention a person of ordinary skill in the art would have found it obvious to have combined dilution monomers, as taught by Rhienberger et al. in the invention of Hashimoto et al. and would have been motivated to do so since Rhienberger et al. suggests that dilution monomers provide composites with high filler contents (5:30-33), and is an equivalent alternative means of providing a polymerizable composition for dental applications.
>
> Ohno et al. (US 5,171,763) provides evidence of dental materials (1:5-15) comprising acid containing monomers (2:20-39), ion-leachable fillers (2:39-41, 10:11-60), and polyfunctional polymerizable compounds having -OH groups {pentaerythritol trimethacrylate} (9:5-10).
>
> Regarding claim 18: Hashimoto et al. teaches solvent in 10-150 parts by weight, based on 100 parts organoboron

compound, specifically 0.1-45 wt% (2:16-21; 2:55-3:10; m4:17-25).

Regarding claim 20: Hashimoto et al. teaches the acid group containing polymerizable monomer is 4-methacryloyloxyethyltrimellitic acid and 4-methacryloyloxyethyltrimellitic anhydride (9:36-37)."

Applicants respectfully submit that, with regard to cancelled claims 5, 11, 13 and 19, the foregoing grounds of rejection have been rendered moot.

Applicants respectfully traverse the rejections of claims 1-4, 6-10, 12, 14-18 and 20 on the ground that a *prima facie* case of obviousness has not been established with respect to the presently pending claims.

The Federal Circuit has ruled that a *prima facie* case of obviousness must establish: (1) some suggestion or motivation to modify the references; (2) a reasonable expectation of success; and (3) that the prior art references teach or suggest all claim limitations. Amgen, Inc. v. Chugai Pharm. Co., 18 USPQ2d 1016, 1023 (Feb. Cir. 1991); In re Fine, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988); In re Wilson, 165 USPQ 494, 496 (C.C.P.A. 1970).

A *prima facie* case of obviousness must also include a showing of the reasons why it would be obvious to modify the references to produce the present invention. See Ex parte Clapp, 277 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985). The examiner bears the initial burden to provide some convincing line of reasoning as to why the artisan would have found the claimed

invention to have been obvious in light of the teachings. Id. at 974.

Applicants respectfully submit that a *prima facie* case of obviousness has not been established as there is no motivation in the prior art to lead one of ordinary skill in the art to modify the teaching of Hashimoto, et al., in view of Rhienberger, et al., when taken with Ohno, et al., to obtain the dental adhesive composition of the present invention.

As recited in claim 1, the present invention is:

"A dental adhesive composition comprising:

(A) a polyfunctional polymerizable monomer selected from the group consisting of glycerol dimethacrylate and tetramethylolmethane triacrylate, in an amount of 1 to 30 parts by weight,

(B) a monofunctional (meth)acrylate having no hydroxyl group in an amount of 65 to 95 parts by weight,

(C) a polymerizable monomer having an acid group, in an amount of 1 to 10 parts by weight, and

(D) an organoboron compound in an amount of 0.5 to 10 parts by weight based on 100 parts by weight of the total of the polyfunctional polymerizable monomer (A), the monofunctional (meth)acrylate (B) and the polymerizable monomer (C) having an acid group,

with the proviso that the total of the component (A), the component (B) and the component (C) is 100 parts by weight."

Similarly, claim 16 recites the inventive dental adhesive composition as:

"A dental adhesive composition comprising:

(A) a polyfunctional polymerizable monomer selected from the group consisting of glycerol dimethacrylate and tetramethylolmethane triacrylate, in an amount of 1 to 30 parts by weight,

(B) at least one monofunctional (meth)acrylate having no hydroxyl group selected from the group consisting of alkyl (meth)acrylates, (poly)alkylene glycol monoalkyl ether (meth)acrylates, fluoroalkyl esters of (meth)acrylic acids, silane compounds having (meth)acryloxyalkyl groups, and (meth)acrylates having heterocyclic rings, in an amount of 65 to 95 parts by weight,

(C) a polymerizable monomer having an acid group, in an amount of 1 to 10 parts by weight, and

(D) an organoboron compound in an amount of 0.5 to 10 parts by weight based on 100 parts by weight of the total of the polyfunctional polymerizable monomer (A), the monofunctional (meth)acrylate (B) and the polymerizable monomer (C) having an acid group,

with the proviso that the total of the component (A), the component (B) and the component (C) is 100 parts by weight."

Their respective dependent claims include all of the limitations of their parent claim and the following comments are

equally applicable thereto in response to the examiner's rejection.

As such, the dental adhesive composition comprises:

(A) a polyfunctional polymerizable monomer specifically selected from one of either glycerol dimethacrylate or tetramethylolmethane triacrylate,

(B) a monofunctional (meth)acrylate having no hydroxyl group, said monofunctional (meth)acrylate being specifically limited in claim 16 as recited,

(C) a polymerizable monomer having an acid group, and

(D) an organoboron compound.

The composition disclosed in Hashimoto, et al. does not contain either glycerol dimethacrylate or tetramethylolmethane triacrylate, component (A) herein, and, thus, belongs to the compositions represented by Comparative Example 1 of the present invention. As is clearly shown in Examples 1-6 in comparison to Comparative Example 1, the inclusion of the polyfunctional polymerizable monomer in the present invention has the effect of significantly enhancing the curing rate of the resulting adhesive without adversely affecting the adhesion properties of the composition, the properties of the cured product and the working time thereof.

According to the present invention, and as shown by the examples therein, the addition of a small amount of a polyfunctional polymerizable monomer having a specific structure

to a dental adhesive composition significantly enhances the curing rate without adversely affecting the adhesion properties of the composition, the properties of the cured product or the working time thereof.

Examples 1-5 of the present invention, as summarized in Table 1, present the composition of the present invention, as amended herein, where the polyfunctional polymerizable monomer is glycerol dimethacrylate. Similarly, Example 6, as summarized in Table 1, presents the composition where the polyfunctional polymerizable monomer is tetramethylolmethane triacrylate. As shown particularly in Examples 1 and 6 in Table 1, the compositions of the present invention corresponding to Hashimoto, et al. have significantly improved curing times and bond strength to dentine and metal, without any reduction in their pot life, or working time. Thus, the present invention clearly shows an advantage neither disclosed nor suggested by the teachings of Hashimoto, et al.

The examiner acknowledges that Hashimoto, et al. fail to teach that the polyfunctional polymerizable monomers based on methacrylic acid esters of a polyhydric alcohol containing 1-2 hydroxyl groups as recited in the present claims, specifically glycerol dimethacrylate or tetramethylolmethane triacrylate, and relies on Rheinberger's disclosure of the inclusion of dilution monomers (based on methacrylic acid esters) which contain at least two polymerizable groups and 1-2 hydroxyl groups,

particularly glycerol dimethacrylate, in a dental composite material.

The examiner contends that Hashimoto, et al. and Rhienberger, et al. are combinable because they are both concerned with a similar technical difficulty, namely the preparation of dental materials.

However, Applicants respectfully point out that the examiner has ignored the fact that Rhienberger, et al. specifically exclude the use of acidic monomers in its quest for a polymerizable composite material whereas Hashimoto, et al. which is particularly directed to a polymerization initiator for dental and surgical adhesives, includes in such adhesives polymerizable monomers having an acid group (column 9, lines 28-57) with the acidic monomers comprising 2 to 20 parts by weight based on 100 parts by weight of all the polymerizable monomers (a) of the adhesive composition. Similarly, the present invention recites, as component (C), a polymerizable monomer having an acid group.

In contrast, Rhienberger, et al. specifically teach a mixture of at least one non-acidic, non-ionic, hydrophilic crosslinking monomer and at least one non-acidic, non-ionic, hydrophilic dilution monomer having a viscosity of less than 1 Pas. (Column 4, lines 53-56).

In defining "non-acidic", Rhienberger, et al. state:

> "The term non-acidic compounds refers to monomers which cry no strongly acidic groups such as carboxyl, phosphoric acid, phosphonic

> acid, phosphinic acid, or sulphonic acid groups and which preferably also contain no weakly acidic groups such as phenolic OH groups, SH groups or CH-acidic groups such as β-diketone groups or β-diketoester groups." (Col. 5, lines 1-7)

With this clear teaching against the use of acidic compounds in the monomers of Rhienberger, et al., Applicants respectfully submit that even though both references are concerned with a similar technical difficulty, namely the preparation of dental materials, there would be no motivation to apply any part of Rhienberger, et al., in combination with Hashimoto, et al., to achieve the present invention. Since Hashimoto, et al. clearly include acidic monomers, incorporating the teaching of Rhienberger, would require that one of ordinary skill completely ignore the clear prohibition of the secondary reference against such acidic compounds. As such, there would be no motivation to combine those teachings with the expectation of success argued by either reference. Indeed, the teaching of Rhienberger, et al. is such that one would not expect success with respect to obtaining the degree of ion release and other properties disclosed by the secondary reference if one incorporated its teachings into polymerizable compositions which include the prohibited acidic monomers. Thus, it cannot be said that one of ordinary skill in the art would look to the teaching of Rhienberger, et al. to cure any deficiencies in Hashimoto, et al.

As for Ohno, et al., Applicants respectfully submit that this reference is directed to a curable composition wherein the

acid containing vinyl monomer component far exceeds that in the present invention. As recited in claims 1 and 16 herein, the dental adhesive composition comprises "(C) a polymerizable monomer having an acid group, in an amount of 1 to 10 parts by weight" whereas the curable composition of Ohno, et al., requires "100 parts by weight of a vinyl monomer containing not less than 30% by weight of an acid group containing vinyl monomer represented by formula (I)". Thus, Ohno, et al. fail to suggest a dental adhesive composition corresponding to the present invention where the polymerizable monomer having an acid group is no more than 10% of the total polymerizable components. Even if one accepts the examiner's position that Ohno, et al. provide evidence of dental materials comprising acid containing monomers, ion-leachable fillers, and polyfunctional polymerizable compounds having -OH groups {pentaerythritol trimethacrylate}, the reference fails to disclose the specific polyfunctional polymerizable monomers as claimed (glycerol dimethacrylate or tetramethylolmethane triacrylate) in combination with the other recited components of the present invention so as to suggest the present composition either alone or in combination with Hashimoto, et al., or Rhienberger, et al., either singly or in combination.

In view of the foregoing, Applicants respectfully submit that a *prima facie* case of obviousness of the present invention has not been established by the combination of Hashimoto, et al.

and Rhienberger, et al., taken with Ohno, et al., and that the rejection of claims 1-4, 6-10, 12, 14-18 and 20 under 35 U.S.C. §103(a) is without support and should be withdrawn.

Applicants respectfully submit that the rejections of claims 1-4, 6-10, 12, 14-18 and 20 under 35 U.S.C. §103(a) have been overcome or are without support and are distinguishable over the prior art for the reasons given herein. Accordingly, Applicants respectfully submit that claims 1-4, 6-10, 12, 14-18 and 20 as presented herein are allowable over the prior art of record and an early notice of allowance is respectfully requested.

Respectfully submitted,

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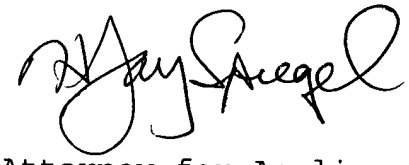

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